Study on the macrobenthic biodiversity along Tarapur coastal sites, India with emphasis on polychaetes

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1. Introduction

The oceans are the main source of biotic energy for the survival of human beings (Nahle, 2008). The ocean majorly divided in four zones *viz.* Open ocean zone, Neretic zone, Benthic zone and Intertidal zone, where the largest ecosystem of earth containing various flora and faunas flourishes. Off which, the intertidal zone is most dynamic and highly sensitive to tidal amplitude and highly variable environment.

The abnormous fluctuation in physico-chemical environment such as temperature fluctuation due to tidal exposure, salinity variation due to fresh water inflow, rain etc., sediment quality because of dislodging by wave action, anthropogenic activities such as industrialization, tourism, conventional fishing activities, discharge of effluent – sewage and many more reasons made the inhabitants of these zone to evolve a range of adaptation to overcome such adverse situations. Genarally, the waste water is discharged directly into the marine environment exerts adverse impacts on quality of water and sediment in conjunction with benthic communities, by increasing organic content, nutrient and heavy metals (Kress *et al.* 2004).

The benthic organisms of the intertidal zone are one of the key links in marine food chain. The presence of large substratum and sufficient light for the luxurious plant growth, the intertidal zone provides nourishment, shelter, and base for many associated organisms (Nair and Thampy, 1980). The coastal area is exploited for many available resources such as, fishing, industrial setups, shipping, refineries, mining, tourism *etc.* which ultimately generates a stressful environment for intertidal benthic communities. The nuclear power plants are one of these industries which utilizes the sea water as a coolant and released back with increased temperature may also affects the coastal environment.

To cope with increase demand of electricity mainly due to industrialization and over population many countries are inclined towards the use of nuclear energy. In India, the first commercial atomic power station was commissioned at Tarapur - Boisar, Maharashtra. It is situated at a distance of 100 km north of Mumbai and has been in operation successfully since 1965.

Biological diversity sustenance is precedence for nature conservation in terrestrial, fresh and marine environments (Brooks *et al.*, 2006). Normally biodiversity study is used for environmental monitoring in ecological studies, but apart from this, it is also used as a tool to

compare different habitats (Magurran 1998). Currently it becomes significant to recognize the consequence of pollution on marine biodiversity, as the information acquired from affected areas and research findings will help to avoid biodiversity loss (Agarwal and Agarwal 2000). The marine biodiversity is richer in the shore environment as compared to the open sea (Gray 1997) and it is also subjected to major anthropogenic threats in the forms of habitat loss, environmental deterioration, overexploitation and global climate changes (Lundin and Linden 1993; Fluharty 1994; Norse 1994; Sebens 1994; Suchanek 1994).

A number of investigators have explored the biodiversity of the benthic environment in favor of formulating sufficient marine preservation and protection measures (Dauer 1993; Reiss and Kroncke 2005; Dolbeth et al., 2007 and Musale and Desai 2011). Macrobenthos comprise a principal functional constituent in marine ecology and disclose a wide variety of compliance to diverse marine and coastal habitations (Lu, 2005). The study species distributions and diversity of macrobenthic community in time and space gives better representation of environmental disturbance (Sanders, 1958). On the basis of size, they are classified as microbenthos (below 63 microns), meiobenthos (between 63 – 500 microns), and macrobenthos (above 500 microns) (Mare, 1942; Mclntyre, 1969; Rees, 1984; Bachelet, 1990). The benthic faunal abundance in an region is intimately associated its surroundings and revealed the uniqueness of an environmental position (Ansari *et al.* 2003).

They are suspension feeders, filter feeders, carnivores, epiphytic grazers, detritus feeders, and scavengers. In the trophic system, meiobenthos depends on bacteria for food and in turn, become the food of macrobenthos which is prayed by pelagic fishes and thus transferred the energy from lower to a higher level. After death and decay of higher organisms, it again comes down to the bottom and used by deposit feeder (Harkanta 1998; Savich 1972; Crisp 1971; Shou *et al*., 2009).

Macrobenthos include species with different life cycles and specific tolerance to stress and referred to as bio-indicator. They provide an integrated response to environmental problems for longer duration due to their sedentary nature, longest life span and variable stress tolerance (Bilyard, 1987; Gray and Elliot, 2009).

In biomonitoring study health of marine environment evaluated by using polychaetes as indicator for organic pollution (Remani *et al.* 1983; Warwick and Ruswahyuni 1987; Jayaraj *et*

al. 2007) and anthropogenic impact with substantial reduction in time and hard work (Kröncke *et al.* 2001; Carroll *et al.* 2003; Sivadas *et al*. 2010). Due to their numerical dominance and diver nature (Quiroz-Martinez *et al.* 2011) they have significant importance in the stability and functioning of the benthic community and subsequently ecology (Belan, 2003; Pearson and Rosenberg, 1978). Polychaetes are having a diversity of feeding modes (Hutchings, 1998) and are one of the most copious foods for birds, fishes and epibenthic invertebrates (Nybakken, 1993). They form an essential constituent in the marine tropic chain particularly providing vital nutrient source for various mammals and demersal fish (Parulekar *et al.* 1982; Herman *et al.* 2000). They serve as enormously assorted class and exhibiting extensive range of reproductive strategy (Hutchings, 1998). They are one of the best indicator of environmental disturbance (Parulekar 1972; Khan and Murugesan, 2005; Giangrande et al. 2005; Dean 2008; Surugiu *et al.* 2010; Musco *et al.* 2011) as they contain both sensitive and opportunistic species in a gradient from pristine to heavily disturbed habitat (Pocklington and Wells 1992). Due to differential response to unusual environmental disturbances (Sukumaran *et al.* 2016) they serve as excellent marker along with this they are having capacity to recolonize again in the disturbed area as pioneer benthic taxa (Abe *et al.* 2011).

They contribute a crucial responsibility to the marine environment as they are concerned with mineralization, promoting and mixing of sediment, flux of oxygen into the sediment and cycling of organic matter (Snelgrove 1998; Heilskov and Holmer 2001). Polychaetes provide important information on ecotoxicological assessment of polluted sediments and further support exploration of their potential for use in biomonitoring applications (Won et al., 2008), therefore, polychaete taxon has been widely accepted and successfully demonstrated for assessing the health of the marine environment (Sivadas et al., 2010).

Therefore, the present work of systematic investigation on the diversity of macrobenthos and polychaetes along with physicochemical and hydro-sedimentological parameters was undertaken. The main objective of the study is to create baseline data on macrobenthos and polychaete diversity around Tarapur Atomic Power station, which can be further exploited for advanced research projects.

Objectives

1. To study the diversity, community structure and composition of macrobenthos along with Tarapur coastal sites, India.
2. To observe diversity, abundance and species composition of polychaete around Tarapur coastal sites.
3. To investigate the impact of anthropogenic activities on the distribution pattern of macrobenthos and polychaete.
4. To check environmental influences on the polychaete community.
5. Discover interrelation between physicochemical and hydro-sedimentological parameters with macrobenthic polychaete.
6. Explore the possibility of pollution-specific indicator species.

2. Review of Literature

Newell (1970) promoted that intertidal zone as more adapted region, as it experiences different tidal exposure, leading to divergence in terms temperature, salinity and ultimately giving physiological, behavioural changes. Ray-Culp *et al*., in 1999 and Arjunan *et al*., in 2010 had stated that about 80% of all marine species occur in coastal zone. Gray (1994) stated that coastal region comprises an extensive range of habitation to support high species diversity, like sedimentary habitat. Gray (1981) studied macrobenthic communities of intertidal as well as subtidal habitats, as they played one of the important roles of indicator for environmental effects. Macrofauna become accustomed mechanism to overcome adverse situation such as quite inactive till return of favourable environment, shift or die. Wetzel (1983) explained that these adjusting natures of macrofauna to ecological alteration are responsible for their distribution, growth and reproductive potential. Gauffin and Tarwell (1952); Wilhm and Dorris (1968) and Resh et al. (1995) stated that benthos are responsive to aquatic environment and demonstrate satisfactory steadiness in assemblage pattern over time to make them valuable tool for long-term monitoring programme.

In India, benthic exploration was initiated on northeast coast by Annandale (1907) for brackish water ponds of Port Canning in Bengal. Annandale and Kemp (1915) studied ecology of Gangetic delta and the fauna of Chilka Lake. Whereas, Ganapathi and Lashmana, (1959) observed benthos continental shelf of northeast coast of India. Later, Ansari *et al.* (1977b) and

Harkantra *et al.* (1982) gave an account on benthos and Rodridues *et al.* (1982) studied meiobenthos of Bay of Bengal. Annapurna and Rama Sarma (1986) conducted detailed research on ostracods in the Bimili backwaters (Gosthani estuary). Benthic polychaetes from the coastal waters of Paradip, Bay of Bengal studied by Ingole *et al.* (2007).

Balasubrahmanyan (1964) conducted research on ecology of Vellar estuary with detail account of intertidal and estuarine polychaete. Khan *et al.* (1975) Chandran *et al.* (1982), Fernando *et al.* (1984) and Chandran (1987a, 1987b) explored various aspects regarding of bottom fauna and hydrobiological studies in gradient zone of Vellar estuary. Ecology of benthic macrofauna in Cuddalore- Uppanar backwater, southeast coast of India was scrutinized by Prabha Devi and Ayyakkannu (1989). Jagadeesan and Ayyakkannu (1992) monitored seasonal variation in benthic fauna in marine zone and inshore waters, whereas Prabhadevi (1994) worked on ecology of Coleroon estuary.

Kailasam (2004) completed two year research on benthic fauna of Tuticorin bay in relation to thermal effluent discharge and found increased temperature of receiving water body negatively correlated with species diversity, benthos density and benthos biomass. Khan *et al.* (2004) introduced macro invertebrate as new pollution indicator. Khan and Murugesan (2005) from India envisaged an account on polychaete diversity in Indian estuaries. Kundu *et al.* (2009) worked on macro-benthic infaunal community in the inshore waters of Parangipettai coast to assess impact of seasonal variation and biodiversity. Kumar and Khan (2013) investigated impact of seasonal variation of macrobenthic diversity and associated environmental parameters from Pondicherry mangroves.

Quantitative studies on the benthic macrofauna, winter cooling and salinity distribution from northwestern Arabian Sea shelf were made by Parulekar and Wagh (1975), Qasim (1982), Radhakrishna *et al.* (1978), Kumar and Prasad. (1996) and Kumar and Mathew (1997). Parulekar *et al.* (1982) assessed benthic production in order to study demersal fishery resources of the Indian seas. Govindan *et al.*, (1983) conducted studies on benthic macrofauna from south Gujarat estuaries, whereas Reghunathan *et al.* (2002) investigated impact of turbidity on the intertidal macrofauna at Gopnath, Mahuva and Veraval coasts.

On southwest coast, Kurian (1953), Desai and Krishnankutty (1966); Desai and Krishnankutty (1967a); Desai and Krishnankutty (1966b), Kurian (1971), Harkandra (1975);

Bhat and Gupta (1986); Bhat and Neelakandan (1988); Bandyopadhyay and Datta (1988) and Gopalakrihnan and Nair (1998).

Parulekar and Dwivedi (1973) conducted extensive work on Goa coastal area regarding benthic studies mainly focusing on standing crop and faunal composition in relation to bottom salinity distribution and substratum characteristics in the estuary of Mandovi River. Ansari *et al.* (1986) explored macrofauna for distribution, production, spatial and temporal variation from a number of Goa estuaries such as Mandovi, Zuari, Mulki *etc*. Achuthankutty (1976) investigated ecology of Sancole beach whereas, Ansari *et al.* (1994) studied macrobentic assemblage of Marmagoa harbour.

Ingole *et al.*, (2009) did comparative study of macrobenthos to assess health status of three harbours from west coast of India and observed stress since there was dominance of opportunistic species. Sivadas *et al*., (2010) used benthic polychaete as an assessment tool to check the environmental quality of the harbour and successfully demonstrated the use of polychaete taxon for evaluating the health of marine environment. Sivadas *et al.* (2014) studied associated fauna of sponges. Sivadas and Ingole (2016) used distribution data of different species belonging to three benthic groups to evaluate the role of environmental factors and coastal currents on the biogeography patterns.

Quantitative studies on benthos off Bombay region were done by Parulekar et al. (1976). Since then at Vashishta Godavari estuary site biological characteristics explored by Nair et al. (1998) and abundance and distribution of polychaete -Dendronereis arborifera Peters, 1854 by Sarma and Rao (1982) apart from this number of researcher were scrutinized population ecology and community structure of macrobenthos from different parts of Maharashtra such as Versova, Rajapur bay, Thane creek, Dabhol coastal region etc. (Varshney *et al.*, 1988; Vizakat lathika *et al.* 1991; Harkantra and Parulekar 1994; Qauadros *et al.* 1996; Athalye and Gokhale 1998; Ingole *et al.* 2002). Qauadros *et al.* (2009) studied polychaetes assemblage and related ecological factors of extremely contaminated Thane creek of the west coast of India, to recognize creek ecology and the effect of various anthropogenic activities like industrial, domestic and solid waste disposal along with land reclamation. With the view of baseline for future environmental monitoring program Sukumaran and Saraladevi (2009), studied the polychaete diversity of Mumbai port. Sukumaran et al. (2011) also studied macrobenthic polycahete for

accurate assessment and management of coastal environment. Their study indicated that polychaete distribution and diversity in the Ratanagiri Bay affected by variation in sediment texture.

3. Study area

During the present study the samples for various physico-chemical and diversity studies were collected from both south and north side of atomic power station from monsoon 2013 to pre-monsoon 2015. In total 13 intertidal locations were selected and divided two zones viz. zone I includes the locations within 10 km radius and sampled monthly (from July 2013 to June 2014) as well as seasonally (from monsoon 2013 to pre-monsoon 2015). Zone II includes the locations within the 10 km to 30 km radius and sampled half yearly (from 2013 to 2015). The GPS positioning, frequency, and distance of locations from atomic power station is given in following table.

Table no. 1: GPS coordinates of sampling locations around TAPS.

Sl. No.	Sampling locations	GPS coordinates	Distance from site area	Frequency of collection
1.	TAPS 1&2	N -19^{0}50.003’ E -72^{0}39.139’	0 km	Monthly / Seasonally
2.	TAPS 3&4	N-19^{0}49.533’ E -72^{0}39.557’	500 m	Monthly / Seasonally
3.	Light House	N -19^{0}50’32.1” E -72^{0}39’21.6”	0.8 km (NE)	Monthly / Seasonally
4.	Chinchani	N -19^{0}52’35.6” E -72^{0}40’51.7”	5 km (NE)	Monthly / Seasonally
5.	Varror	N -19^{0}54’32.4” E -72^{0}40’35.6”	8.4 km (NE)	Monthly / Seasonally
6.	Vadhavan	N -19^{0}55’39.48” E -72^{0}40’08.32”	10 km (NE)	Half yearly
7.	Tadyalpada	N -19^{0}57’54.15” E -72^{0}42’15.14”	13.5 km (NE)	Half yearly
8.	Gholvad	N -20^{0}04’54.82” E -72^{0}43’32.00”	30 km (NE)	Half yearly
9.	Ucheli	N -19^{0}48’07.9” E -72^{0}41’13.6”	5 km (SE)	Monthly / Seasonally
10.	Nandgaon	N -19^{0}45’09.0” E -72^{0}41’19.2”	8 km (SE)	Monthly / Seasonally
11.	Murbe	N -19^{0}44’08.96” E -72^{0}42’05.47”	10 km (SE)	Half yearly
12.	Satpati	N -19^{0}43’10.31” E -72^{0}42’14.93”	13.5 km (SE)	Half yearly
13.	Edwan	N -19^{0}32’24.54” E -72^{0}43’19.82”	30 km (SE)	Half yearly

Note: all the distances were measured from TAPS 1&2.

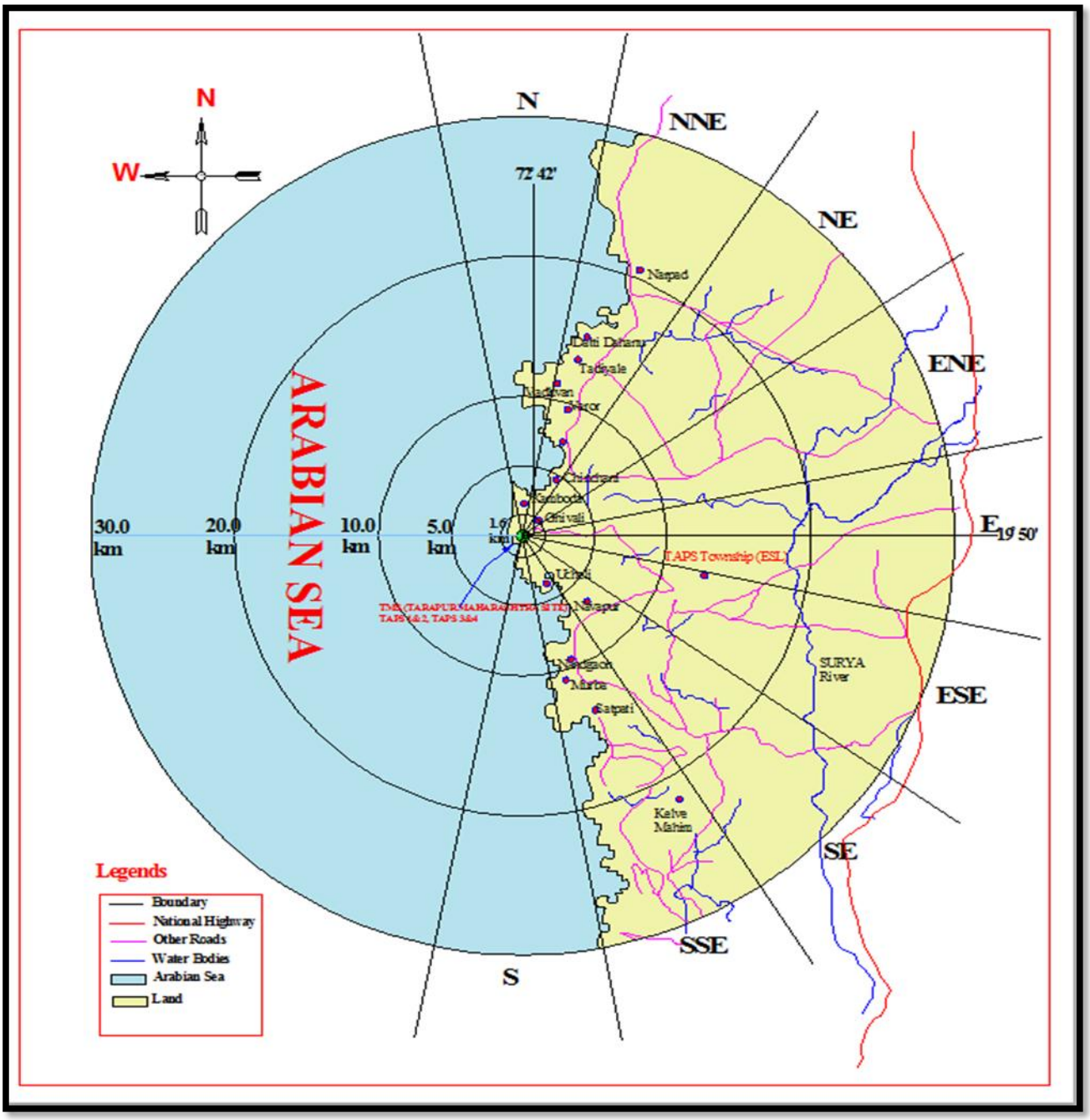

Figure 1 Map showing present sampling locations.

4. Material and Methods

A] Physico-chemical and hydro-sedimentologcal study:

Water and sediments sample were collected and stored in pre-cleaned plastic containers. Chemical analysis of water sample was done by using standard methods for the parameter such as pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate and phosphate (APHA, 2012;

Strickland and Parson, 1968; Grasshoff, 1999). Sediment samples were analyzed for organic carbon and texture (Kim, 1996).

B] Macrobenthic and polychaete study

Sediment for macrobenthos were collected by quadrate method and washed through 500 micron sieve and organisms retained were stained with 1% rosebengal and preserved in 5% buffered formalin (McIntyre, 1969). All stained organisms sorted from the samples were further identified to the group level and the polychaetes to the lowest possible taxa. Species level identification was based on the identification keys of Fauvel (1932), Gosner (1971), Parulekar (1972), Day (1967), Faukald (1977), Faukald and Rouse (1977).

C] Data analysis

Location and hydro - sedimentological parameters will be compared statically for interpretation of diversity. Data analysis will be done using excel, STASTICA and PRIMER (Plymouth Routine In Multivariate Ecological Research) software (UNEP, 1995) which include Univariate technique such as Shannon – Wiener diversity index (H'), Margalef's index (d) and Pielos evenness index (J) and multivariate analysis like square root transformed data using the Bray – Curtis Similarities by non-metric multidimentional scaling (MDS). Data represented graphically by using software 'Origin 6'.

5. Results

5.1 Physico-chemical parameters of water and sediments around Tarapur coast

Water and sediment samples were collected and analyzed physical and chemical changes for monthly variations July 2013 to June 2014; seasonally monsoon 2013 to pre-monsoon 2015 and half yearly during period of July to December 2014, January 2014 to June 2014 and during the period of January to June 2014.

During monthly study air temperature ranged from 21.5^0C (August, 2013) to 33.9^0C (October, 2013) with an average 29.14 $\pm 0.39^0$C whereas, water temperature got varied from 21^0C (TAPS 3&4 -August 2013) to 38.5^0C (Light house – May 2016) was due to upwelling effect, a well-known fact occurring after South–West monsoon period (Alvarez-Borrego, 1982)

and also due to cloud coverage during monsoon leads to reduction in solar heat reaching to the surface. Seasonally it was observed minimum during post-monsoon 2013 (TAPS 1&2 and TAPS 3&4) and maximum during pre-monsoon 2014 (Chinchani) whereas water temperature found minimum during monsoon 2013 and maximum 32.5^0C during post-monsoon 2013. These results indicate the seasonal pattern of variation. In post-monsoon season the strong cold land breezes cause the reduction in surface water temperature (Anitha and Sugirtha, 2013). At west coast of India, highest atmospheric and surface water temperature is high in the months of March to July (*i.e.,* pre-mosnoon) and lowest from July to February (*i.e.* monsoon and post-monsoon) (Baware *et al.,* 2013). Half yearly it was in the range of 19^0C (during June to December 2014) to 32^0C (during January to July 2014). In the present study, salinity is positively correlated with hardness (r = 0.406) and negatively correlated with alkalinity (r = -0.257). There was no correlation between water temperature and salinity, indicates it was not the effect of water temperature rise. Monthly and seasonally variations in the pH values were in the range 7 to 8.5 and half yearly survey it was in the range of 7.9 to 8.4. The microbial action led to slightly acidic condition, pH '6.75', which was seasonal effect and noticed during premonsoon'14 for the month of March'14.

During half yealry study alkalinity was varied from 86 mg/l during January to June 2014 at Gholwad to 168 mg/l during January to June 2014 period at Satpati, respectively. The DO was recorded minimum of 3.5 mg/l at Chinchani, the possible reason was high turbidity of sample due to wave action at sandy beach. The maximum DO was recorded at Varor location (8.6 mg/l) during July 2013, *i.e.,* onset of the monsoon season. Seasonally the maximum DO noticed during monsoon is a combined effect of higher wind energy coupled with rainfall (Saravankumar *et al.,* 2008). Dissolved oxygen was in the range of 3.5 mg/l to 8.5 mg/l with an exceptionally low DO during premonsoon'14 at Uchheli, since at this location there were domestic as well as industrial wastes, directly discharged into the creek which lowered the concentration of DO in surrounding water body.

Organic carbon is correlated with organic contaminants and, therefore, can be used as tool for level of contamination and toxicity (MacDonald and Ingersoll, 2010), and it also plays an important role in maintaining the productivity of water body. During the present study the organic carbon content was maximum at Light house location, was mainly due high clay content and mangrove vegetation. It is positively correlated with clay (r = 0.579). The sediment texture

shows the trend of sand> silt> clay also showed seasonal fluctuation as minimum 82.9% (sandy) in pre-monsoon 2015 and maximum 94.9 % (sandy) in Monsooon 2013. Intertidal locations selected for study were all rocky structures with high percentage of sand followed by silt and clay except at Light house, Varor and Uchheli where percentage of clay and silt was higher than other locations.

5.2 Diversity of macrobenthos around coastal site of Tarapur Atomic Power Station

In the present study, samples for the macrobenthic invertebrates were collected from seven different locations within 10 km radius of atomic power station, Tarapur; from both south as well as north side, during monthly (from July 2013 to June 2014), seasonally (monsoon 2013 to pre-monsoon 2014) and half yearly (June 2013 to December 2014).

Totally, 12 phylum represented by 33 different faunal groups were identified during monthly and seasonal study however 8 phylum represented by 23 faunal groups. Faunal composition shown there were three dominant faunal groups during monthly *viz.*, polychaetes 86.5 %, amphipods 6.9 % and isopods 2.4%; 4 faunal groups during seasonal *viz.*, polychaete 91.39%, amphipods 3.78%, tanaids 1.20% and isopods 1.14%; six faunal groups during half yearly *viz*., polychaete 79.38%, amphipods 6.15%, tanaids 4.51%, isopods 2.68%, copepods 2.18%, cumaceans 1.74%.

Margalef's richness (d') observed minimum 0.47 at Uccheli in June 2014 and maximum 5.39 with an average 0.65 ±0.22 at Varor in December 2013 during monthly study. Seasonally it was varied from 0.66 during monsoon 2013 at Uchheli to 5.89 with an average 2.83±1.33 during postmonsoon 2014 at Varor. Whereas half yearly study, it was noticed as 1.25 at Satpati to 3.23 with an averages 2.12±0.55 at Tadayalpada (during July 2013 to December 2013).

During monthly study the Shannon Wiener index (H') values were observed lowest during June 2014 (2.00) to February 2014 (2.77) with an average of 2.48 ± 0.23. At Varor, the highest ranges from 2.32 (during May 2014) to 3.63 (during October 2013) with an average of 2.95 ± 0.45. Seasonally, the Shannon Wiener index (H') values varied from 0.89 (Uchheli) to 3.05 (Varor) with an average of 2.44 ± 0.72 at post-monsoon 2013. During monthly study Pielous evenness (J') was varied from 0.20 during April 2014 at Uchheli to 0.93 during October 2013 at Varor with an average 0.71 ± 0.15. Seasonally, it was varied from 0.25 during monsoon 2013 at Uchheli to 0.91 at Varor during postmonsoon 2014 with an average 0.71 ±0.15.

The *k*-dominance curves were plotted for all seasons with all locations. The lower line is indicating highest diversity while upper line indicates less diversity of macrobenthos during the present study. The similarity among locations during all seasons was calculated for monthly, seasonally and half yearly survey with respect to macrobenthos assemblages along with MDS plot. To interpret the effect of marine pollution; the structure of benthic communities is widely used. The benthic communities are sessile or slow moving and show the impact of disturbance within a short period. During the month of November 2013, February 2014, March 2014 and May 2014, the k-dominance plot showed maximum diversity which was indicated by the line lying lower on the plot. The macrobenthos abundance at Light house showed the minimum diversity during the months of September 2013, which was indicated by the line lying up on the plot. At Varur, the maximum diversity represented by the lines lying lower on the plot was observed during the months of October 2013, August 2013, November 2013, December 2013 and March 2014. K-dominance plot for Nandgaon location showed minimum diversity recorded during the months of July 2013 and June 2014, which is indicated by the line lying up on the plot. ABC plot denoted that there was negative impact of monsoon on faunal distribution.

5.3 Diversity of polychaete around Tarapur coastal site

Total 82 species were identified during July 2013 to June 2014 among which maximum number of species noticed at Varor (72) during March 2014 and minimum at light house (10) during June 2014. During the study period, the maximum number of polychaete (72) were recorded at Varor during March 2014 and minimum number was recorded (10) at Light house during June 2014. The maximum number of individuals were recorded at Nandgoan and it was 637 no. during November 2013 month. The Margalef's richness (*d*), at TAPS 1&2 location was found lowest during the month of July 2013 (4.4) and highest in the month of February 2014 (10.67) with an average of 8.00 ± 2.15. At Chinchani, it was ranged from 1.21 (June 2014) to 10.92 (September 2013). Pielou's evenness (*j*) values was found in more or less similar pattern for polychaete species, distributed evenly throughout study period.At TAPS 3&4, it varied from 0.97 (during July 2013 and June 2014) to 0.99 (during the months of August 2013, September 2013, December 2013, January 2014, February 2014, March 2014, April 2014 and May 2014) with an average of 0.99 ± 0.01. At Uchheli, it was observed the average of 0.97 ± 0.02 monthly. At Nandgoan, it was seen from 0.94 (August 2013) to 0.99 (September 2013) with an average of

0.98 ± 0.01. However, At Light house and Chinchani, there was not much variation in Pielou's evenness values. The Shannon Wiener index (*H'*) (log_2) was observed in the range of 4.23 during July 2013 to 5.93 during the month of May 2014. At Uchheli, it fluctuated from 2.93 (September 2013) to 5.51 (May 2014) with an average of 4.94 ± 0.67. At Nandgoan, it varied from 2.55 (September 2013) to 5.72 (January 2014) with an average of 4.73 ± 1.18.

The half yearly survey, the number of species (S) highest (40 no.) was observed at Gholwad location. During the period of January 2014 to June 2014, it ranged from 22 no. at Vadhavan to 38 no. at Murbe location. The number of individuals was recorded minimum of 118 no. at Vadhavan and maximum of 259 no. at Edwan. During January 2014 to June 2014 period, it was maximum observed at Satpati (280 no.). The Margalef's richness (*d*) ranged from 2.3 at Murbe to 7.73 at Gholwad location. During July 2014 to December 2014 period of study, it was in the range of 3.2 at Vadhavan to 7.0 at Murbe location. During July 2013 to December 2013 period, the Pielou's evenness (*j*) was observed minimum of 0.97 at Murbe and maximum of 0.99 at remaining locations except Edwan. During July 2014 to December 2014 period of study, no variation was observed in Pielou's evenness index values. The Shannon Wiener Index (*H'*), was found minimum at Murbe (3.49) and maximum at Gholwad (5.25) with an average of 4.72 ± 0.65.

6. Summary

Along west coast of India a number of researchers studied the ecology and community structure on marine soft bottom macrobenthos. During present study macrobenthic fauna studied under three different criteria - monthly location-wise, second seasonal and third half yearly location–wise around coastal region of India's first commercial power station, Tarapur Atomic Power Station (TAPS). Seven locations were sampled for monthly and seasonal up to 5km and six locations were at 10km, 15km and 30km both towards North and South side of the power plant. Polychaetes were analysed up to species level for monthly (July 2013 to June 2014) and half yearly duration (July 2013 to January 2014). Present study illustrated premier database on macrobenthic and polychaete diversity along with water and sediment characteristics for monthly, seasonal and half yearly study around Tarapur Atomic Power Station.

7. Conclusion

There were total 33different faunal groups identified during monthly study with dominance of polychaete followed by amphipods, isopods and tanaids. During seasonal study, monsoon showed negative impact on diversity throughout study period, where there was succession of new species in post-monsoon season. During rainy season, sediment texture got changed towards more sandy nature and less organic carbon leading to decrease in macrobenthic assemblage and subsequently polychaete species. For better understating of impact of discharged water from power plant elevated temperature, macrobenthic and polychaete study extended 10km, 15km and 30km towards North and South side of Tarapur Atomic Power Station. During present study total 28 polychaete families identified represented by 81 species among which Nereididae represented by 13 species, followed by capitellidae 10 species, Lumbrineridae 6 species, Spionidae 5 species, Syllidae 5 species, Nephtyidae 4 species, Onuphidae 4 species, Hesionidae 3 species and rest of the families represented by1 and 2 species. It was noticed that fluctuations in diversity are associated with sediment texture, local anthropogenic activities as well as seasonal effects.

7. Reference

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- Ajit A. Ambekar, **Priti V. Kubal**, Chandra Prakash and Sivaperumal P. (2016): A study on heavy metals in marine gastropod (*Nerita oryzarum*: Recluz, 1841) at nuclear power plant site, Tarapur, Maharashtra, India. International Journal of Recent Scientific Research Vol. 7, Issue, 6, pp. 11806-11813.

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